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THE GASTEROMYCETES OF AUSTRALASIA.

IX. KEYS TO THE GENERA AND SPECIES OF THE LYCOPERDACEAE.

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[Read 27th July, 1927.]

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THE GASTEROMYCETES OF AUSTRALASIA.

ix. Keys to the Genera and Species of the Lycoperdaceae.

By G. H. Cunningham, Mycologist, Department of Agriculture, Wellington, N.Z.

[Read 27th July, 1927.]

The writer would limit the Lycoperdaceae to those genera possessing a non-stipitate, two- or four-layered peridium, copious capillitium, and long-sterigmate, 4- or 8-spored basidia. The limits of the family have been much greater in the past, as the following classifications will show, but as our knowledge of the development and structure of the various genera have broadened, so the limits of the family have been narrowed.

Details of the various classifications which have been proposed are of little other than historical interest today, to the student of this group, but a few are given here to indicate the diversities of opinion held by different authors, as to the position and affinities of the genera included in the Lycoperdaceae.

Commencing with Persoon's *Synopsis Methodica Fungorum*, 1801 (the starting-point of Modern Nomenclature in the Gasteromycetes), we find he divides the Fungi as under (details of the Gasteromycetes only are given):—

[1] Class I. Angiocarpi: Fungi closed, or bearing very numerous spores internally.
Order 1. Sclerocarpi.
2. Sarcocarpi. Fungi fleshy stuffed. Sphaerobolus, Thelebolus.
3. Dermatocarpi. Fungi membranous, tough, internally powdery.
†Trichospermi. Seed powder mixed with threads. 13. Batarrea. 14. *Geastrum.*[2] 15. *Bovista.* 16. Tulostoma. 17. *Lycoperdon.* 18. Scleroderma (Genera 19-27 are now placed in a separate group, the Myxomycetes).
††Gymnospermi. Seed powder without threads.
†††Sarcospermi. Fructifications abundant, fleshy. 38. Cyathus.

Class II. Gymnocarpi: Fungi fleshy. Seeds (few) borne in an open receptacle.
Order 4. Lytothecii. Fertile membrane at length mucilaginous. 39. Clathrus. 40. Phallus.
5. Hymenothecii (Hymenomycetes).
6. Naematothecii (Hyphomycetes).

As this and other classifications of that period are not in use today, the many others may be omitted, and attention paid only to those which have been in general use in recent years. Perhaps the best known of these is that followed in Saccardo's *Sylloge Fungorum*, Vol. 7, 1888, where the Lycoperdaceae is arranged as under

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[1] Thanks are due to Miss Wakefield, Kew Herbarium, for a translation of Persoon's classification. Unfortunately this work is not procurable in New Zealand.

[2] Genera included by the writer in the Lycoperdaceae are italicized; those excluded by him, or not present in Australasia, are in ordinary type.

(only the arrangement of this family in the various classifications will be considered henceforth):—

Family III. Lycoperdaceae.
Sub-family 1. Podaxineae.
2. Diplodermeae.
Tylostoma, Queletia, Battarrea, Husseya, Mitremyces, *Geaster*, Diplocystis, Diploderma, Trichaster, Broomeia, Coilomyces.
3. Lycoperdeae.
Lanopila, Eriosphaeria, *Bovista, Calvatia, Lycoperdon.*
4. Sclerodermeae.
(*Mycenastrum* is placed here as a synonym of Scleroderma).

Ed. Fischer in Engler and Prantl's *Natuerliche Pflanzenfamilien*, I, 1**, 1900, arranged the family as under:—

Order 3. Lycoperdineae.
Family I. Lycoperdaceae.
Lycoperdon, Globaria, Catastoma (= *Disciseda*), *Bovistella, Bovista, Mycenastrum, Geaster.*

Lloyd's classification (*Genera of the Gasteromycetes*, 1902) is as follows:—

Family 4. Lycoperdaceae.
Tribe 1. Tylostomeae.
2. Podaxineae.
3. Sclerodermeae.
4. Lycoperdeae.
Tribal Alliance i. Geastreae.
Geaster.
ii. Bovisteae.
Bovista, Mycenastrum, Catastoma (= *Disciseda*).
iii. Lycoperdeae.
Bovistella, Lycoperdon, Calvatia.
iv. Anomalae.
Gallacea, Castoreum, Arachnion, Mesophellia, Mitremyces.

Hollos (*Gasteromycetes Ungarns*, 1904), follows the arrangement:—

Family 3. Lycoperdaceae.
Battarea, Tylostoma, Myriostoma, *Geaster*, Astraeus, *Calvatia, Lycoperdon, Disciseda, Bovista, Mycenastrum.*

Carleton Rea (*British Basidiomycetae*, 1922) arranges the family as under:—

Sub-order 3. Lycoperdineae.
Family 1. Lycoperdaceae.
Lycoperdon, Bovistella, Bovista, Myriostoma, *Geaster.*

From a consideration of these classifications we find that Persoon included *Battarrea, Tulostoma, Scleroderma* and the Myxomycetes in the family; that Saccardo placed *Geaster* in a separate sub-family, *Mycenastrum* as a synonym of *Scleroderma*, and included with *Lycoperdon*, etc. such genera as *Lanopila* and *Eriosphaeria*, while *Tulostoma, Mitremyces* (= *Calostoma*), etc. are placed in the sub-family Diplodermeae; that Fischer placed the genera later considered by the writer all under the Lycoperdaceae; that Hollos followed the older school in considering under the Lycoperdaceae such genera as *Battarrea, Tulostoma*, etc.; and that Rea's arrangement was similar to that of Fischer.

It is out of place to consider in detail the reasons why such genera as *Tulostoma, Battarrea, Scleroderma*, etc. do not belong to this family; these reasons will be given in subsequent papers dealing with these genera. As has been shown, the writer limits the family to those genera possessing a copious capillitium (which excludes *Scleroderma*); a non-stipitate peridium (which

excludes *Tulostoma* and *Battarrea*); 4- or 8-spored, sterigmate basidia (which excludes such genera as *Diploderma* and its allies).

All the genera considered as belonging to the family (*Abstoma*, *Bovista*, *Bovistella*, *Calvatia*, *Disciseda*, *Geaster*, *Lycoperdon*, *Mycenastrum* (extra-Australasian genera are not considered here) possess a two- or (in *Geaster*) four-layered peridium; the gleba is composed of spores immixed with copious capillitium threads; no stipe is present in any genus; the basidia are all long-sterigmate, and bear apically 4-8 unicellular spores. The development has been worked out for all genera by the writer, and is in most (save *Geaster*) found to be similar to that of *Lycoperdon*, save in minor details, as the formation of the capillitium threads.

STRUCTURAL SIMILARITIES AND DIFFERENCES IN THE GENERA OF THE LYCOPERDACEAE.

Tribe Lycoperdeae.

In the mature plant a two-layered peridium is always present, and the plants are attached to the substratum by a rooting base (*Bovistella* and *Lycoperdon*) which holds them to the place of origin even when old and withered; or they may be attached by a small rooting strand or mycelial cord and at maturity break away and be carried by the wind for some distance (*Abstoma*, *Bovista*, *Disciseda* and *Mycenastrum*).

The outer layer of the peridium is termed the exoperidium, and is usually pseudoparenchymatous, but may be membranous, and is often composed of warts and spines. This structure is often quite thin and flakes away in irregular patches. In *Abstoma* and *Disciseda* this membrane is frequently a thick (1-3 mm.) sand-case, consisting of loosely woven hyphae with which are immixed sand grains or particles of vegetable matter. The whole structure though firm is quite brittle, and falls away in irregular fragments. The exoperidium is one of the most variable tissues, ranging in the genus *Lycoperdon* from a smooth membrane, through furfuraceous to verrucose and even echinulate. The spines or verrucae seldom fall away completely but usually partly persist, especially towards the base. These structures are usually considered valuable aids in diagnosis, but should be used with caution, as in certain species individual plants in the same collection may possess either furfuraceous, verrucose or even echinulate processes to the exoperidium. In those species which are conspicuously spinose, the spines are usually surrounded at their bases with rings of small granules; consequently when the spines fall, the granules persist, giving to the exposed endoperidium a curiously reticulated appearance (*L. compactum*).

The inner tissue, the endoperidium, is in most genera thick and membranous or papyraceous, but in *Mycenastrum* is thick (2-5 mm.), corky, coriaceous and pseudoparenchymatous, and in growing plants often cartilaginous.

The peridium encloses the gleba, which at maturity consists of capillitium threads and spores. The threads serve as most useful generic characters. In many species of the genera *Bovistella* and *Lycoperdon* is present the so-called columella, a cylindrical or elliptical structure of sterile tissue traversing the lower portion of the gleba and attached to the base of the plant. In certain species of the genera *Bovistella*, *Calvatia* and *Lycoperdon* a sterile base is present. This consists of a usually cellular tissue occupying the lower portion of the gleba, and is most frequent in those plants with a well-developed, stem-like base. In two species (*Lycoperdon polymorphum* and *Calvatia candida*) the sterile base is not cellular but compact, and consequently frequently difficult to differentiate from

the gleba. In certain species of *Calvatia* and *Lycoperdon* (*Calvatia lilacina*, *C. caelata*, *Lycoperdon depressum*) the sterile base is separated from the gleba by a definite diaphragm.

The spores are continuous, globose or shortly elliptical, and possess rough or smooth epispores. Their shape, size and degree of roughness are useful specific characters. They may have long and slender sterigmata (often of irregular size on the same basidium) which in turn are borne apically on small cylindrical or clavate basidia. When the sterigmata with the attached spores break away from the basidia the latter are said to be pedicellate; when stumps only of the sterigmata remain attached to the spores the latter are said to be apiculate (though the use of this term is not strictly accurate, it being used generally in the sense of an apical point or apicula, the pedicel being basal); or should the spores become completely detached from the sterigmata they are said to be apedicellate. The basidia in all members of this tribe are regularly tetrasporous.

Most of the genera show a general resemblance, so close in fact that difficulty is sometimes experienced in separating species of *Bovistella* from *Lycoperdon* or *Bovista*. In the writer's experience separation is best effected by means of the capillitium threads, and method of dehiscence. In *Calvatia* and *Lycoperdon* the threads are very long, even throughout their length, sparingly septate or continuous. They are free at one end, and usually attached by the other to the inner wall of the peridium, or to the columella and diaphragm or sterile base should these be present. In *Lycoperdon* three types of capillitium threads are present; hyaline, septate, simple threads; coloured, continuous, simple or sparingly branched threads; and coloured, freely branched threads. These last approach in appearance those of *Bovista* and *Bovistella*.

Calvatia is separated from *Lycoperdon* chiefly by the method of dehiscence. In the former genus the upper portion of the peridium flakes away in pieces, when at maturity the whole may have disappeared, the gleba then being directly exposed. In *Lycoperdon* dehiscence is effected by a definite apical stoma. In two species (*L. depressum* and *L. Wrightii*) dehiscence is first effected by means of the apical stoma, but as the plant ages, irregular flaking away of the whole of the apex of the peridium occurs; consequently difficulty might be experienced in placing plants of these species, according to whether they were collected when mature or immature. In such cases the peculiar hyaline, septate capillitium serves to separate them.

In *Abstoma* and *Disciseda* the capillitium threads are very short, unbranched and usually continuous; and are so characteristic as usually to place any species in these two genera. Immature plants possess capillitium approaching the *Lycoperdon* or *Calvatia* type. In *Disciseda* dehiscence is effected by a stoma which in most species is apical but in one or two species is said to be basal. In *Abstoma* no stoma is present, the spores being liberated by irregular rupture of the endoperidium.

Bovista and *Bovistella* both possess capillitium threads which are peculiar and characteristic. Each thread is free, and has a short, distinct, thick main-stem, with numerous short, dichotomous, acuminate branches. The threads are penetrated to the lumen by peculiar conic pits (absent in *Bovista purpurea*). Dehiscence is effected by means of an apical stoma, as in *Lycoperdon*. The two genera are separated from one another upon habit, *Bovista* being a genus in which plants break away at maturity from the place of growth, *Bovistella* persisting by means of a rooting base as does *Lycoperdon*. Herbarium specimens may usually

be differentiated by the presence or absence of this rooting base. This in turn is usually indicated by the presence of a sterile base, so that by many workers, *Bovistella* has come to be recognized as a *Bovista* with a sterile base. In the opinion of the writer, however, this is not a sufficiently valid distinction upon which to base a genus.

Mycenastrum is characterized both by the capillitium threads and method of dehiscence. The threads are short, free, short-branched and covered with numerous spinous processes. Dehiscence is effected by the stellate splitting of the apex, but in certain forms, even in the same collection, it may be effected by the irregular breaking away of the apical portion.

Tribe Geastreae.

This is represented in Australasia by the single genus *Geaster.*

The structure of species of this genus differs in that no less than four well-defined tissues are present: (1) An outer mycelial layer consisting of a palisade of stout fibres; (2) a central fibrillose layer of interwoven hyphae with long axes predominantly radial; (3) an inner fleshy layer, definitely pseudoparenchymatous in structure (these three tissues comprise the exoperidium); and (4) the endoperidium.

The exoperidium splits into a variable number of rays, which may be expanded, revolute or involute. Dehiscence is effected by the exoperidium splitting from the apex downwards into several stellate lobes, exposing the endoperidium, which in turn dehisces by an apical stoma. The endoperidium is usually membranous or papyraceous, and may be carried on a short pedicel, or be sessile. The stoma may be a poorly defined aperture, scarcely discernible from the endoperidium—when it is said to be naked; or it may be enclosed within a definite peristome, when it is said to be peristomate. The peristome may be externally fluted, when it is termed plicate; or silky-fibrillose, when it is said to be fibrillose.

The capillitium threads are continuous, simple (save in *Geaster velutinus* where they are sometimes branched at their apices), thick-walled, acuminately pointed and dark-coloured. The basidia are usually 4-spored, but 8-spored forms are not uncommon. A columella is present in certain species, but is noticeable usually only in immature specimens immediately before dehiscence.

The spores are usually globose, usually some shade of brown, and mostly verrucose or verrucose-echinulate.

In the family Lycoperdaceae there are 57 Australasian species, distributed among the following eight genera: *Abstoma* 2, *Bovista* 2, *Bovistella* 3, *Calvatia* 4, *Disciseda* 8, *Geaster* 23, *Lycoperdon* 14, and *Mycenastrum* 1.

Their distribution is interesting, as the accompanying table shows.

Table of Distribution of the Species.

Species.	Distribution.
Abstoma purpureum	New Zealand
Abstoma reticulatum	Australia
Bovista brunnea	New Zealand, Australia
Bovista purpurea	New Zealand
Bovistella bovistoides	New Zealand, Australia, India
Bovistella pusilla	Australia
Bovistella verrucosa	Australia

Species.	Distribution.
Calvatia caelata	New Zealand, Australia, North America, Europe, Asia, Africa
Calvatia candida	Australia, Europe
Calvatia gigantea	New Zealand, Australia, North America, Europe
Calvatia lilacina	New Zealand, Australia, North America, Europe, Africa
Disciseda anomala	Australia
Disciseda australis	Australia
Disciseda candida	New Zealand, Australia, North America, Europe, South America
Disciseda cervina	Australia, North America, Europe
Disciseda hyalothrix	Australia
Disciseda hypogaea	New Zealand, Australia
Disciseda pedicellata	Australia, North America, Africa
Disciseda verrucosa	New Zealand, Australia
Geaster arenarius	Australia, North America
Geaster australis	Australia
Geaster Berkeleyi	Australia, Europe
Geaster Bryantii	Australia, North America, Europe
Geaster campester	Australia, North America, Europe
Geaster Clelandii	Australia
Geaster Drummondii	Australia
Geaster ellipticis	Australia
Geaster fenestriatus	Australia, North America, Europe, Africa
Geaster fimbriatus	Australia, North America, Europe
Geaster floriformis	New Zealand, Australia, North America, Europe, Africa
Geaster Hariotii	Australia, Europe, Africa, South America
Geaster limbatus	New Zealand, Australia, North America, Europe, Africa
Geaster minus	New Zealand, Australia, North America, Europe, Asia
Geaster mirabilis	Australia, North America, Asia, South America
Geaster pectinatus	New Zealand, Australia, North America, Europe
Geaster plicatus	New Zealand, Australia, Africa, India
Geaster saccatus	Australia, North America, Europe, South America
Geaster simulans	Australia
Geaster Smithii	Australia, North America
Geaster subiculosus	Australia
Geaster triplex	New Zealand, Australia, North America, Europe, South America
Geaster velutinus	New Zealand, Australia, North America, Africa, South America
Lycoperdon asperum	Australia, Africa, South America
Lycoperdon compactum	New Zealand
Lycoperdon depressum	New Zealand, Australia, Europe, Africa
Lycoperdon glabrescens	New Zealand, Australia
Lycoperdon Gunnii	Australia
Lycoperdon nitidum	Australia
Lycoperdon perlatum	New Zealand, Australia, North America, Europe, Africa, South America, India
Lycoperdon piriforme	New Zealand, Australia, North America, Europe, South America, Asia
Lycoperdon polymorphum	New Zealand, Australia, North America, Europe, Africa
Lycoperdon pusillum	New Zealand, Australia, North America, Europe, Africa, Asia, India
Lycoperdon scabrum	New Zealand, Australia
Lycoperdon spadiceum	New Zealand, Australia, Europe
Lycoperdon stellatum	Australia
Lycoperdon subincarnatum	Australia, North America
Mycenastrum corium	New Zealand, Australia, North America, Europe, Africa, Asia, India

This table shows that of these 57 species, 27 occur in New Zealand; 54 in Australia; 24 in Europe; 14 in Africa; 5 in India; 26 in North America; 9 in South America; 6 in Asia; 23 being confined to this biological region.

In the genus *Geaster* (and the related extra-Australian genus *Myriostoma*) are certain structural differences that separate it from the other genera placed in

the family. Consequently the family may conveniently be divided into the two following tribes:—

Tribe Lycoperdeae: Peridium two-layered, dehiscing by an apical stoma or by the gradual falling away of the upper portions of the peridium; capillitium attached or free, simple or freely branched; basidia sterigmate, 4-spored.

Tribe Geastreae: Peridium four-layered, dehiscing by the exoperidium splitting from the apex downwards in a stellate manner exposing the endoperidium, which in turn dehisces by means of an apical stoma; capillitium attached, simple; basidia sterigmate 4-8 spored.

The genera may be arranged as under:—

Key to the Genera.

Tribe Lycoperdeae: Peridium 2-layered; basidia 4-spored.
- Capillitium threads attached to the endoperidium and central columella, when present.
  - Peridium dehiscing by irregular apical rupture ..... 1. *Calvatia.*
  - Peridium dehiscing by a definite apical stoma ..... 2. *Lycoperdon.*
- Capillitium threads free within the endoperidium.
  - Threads simple, or short-branched.
    - Threads short, simple, smooth.
      - Stoma present, apical or basal ..... 5. *Disciseda.*
      - Stoma absent ..... 6. *Abstoma.*
    - Threads short, simple, spinose ..... 7. *Mycenastrum.*
  - Threads freely branched, of a central main stem, and short, dichotomous, acuminate branches.
    - Plants with a strong rooting base ..... 3. *Bovistella.*
    - Plants without a definite rooting base ..... 4. *Bovista.*

Tribe Geastreae: Peridium 4-layered; basidia 4-8 spored.
- Peridium with a solitary apical stoma ..... 8. *Geaster.*

In order to bring all species of the family together, the following keys to the species of each genus have been given.

1. Calvatia Fries.
   (For emended descriptions, see Proc. Linn. Soc. N.S.W., 1926, li, p. 363.)
   - Diaphragm present.
     - Spores smooth ..... *C. caelata* (Bull.) Morg.
     - Spores verrucose ..... *C. lilacina* (B. et M.) Lloyd
   - Diaphragm absent.
     - Plants large, exterior smooth and leathery .... *C. gigantea* (Pers.) G. H. Cunn.
     - Plants small, exoperidium furfuraceous ..... *C. candida* (Rostk.) Hollos

2. Lycoperdon Tourn.
   (Descriptions, Proc. Linn. Soc. N.S.W., 1926, li, p. 627.)
   - Spores without distinct pedicels.
     - Capillitium hyaline, freely septate.
       - Diaphragm present ..... *L. depressum* Bon.
       - Diaphragm absent.
         - Exoperidium with minute depressions ..... *L. subincarnatum* Peck
         - Exoperidium reticulate with persistent granules ..... *L. compactum* G. H. Cunn.
     - Capillitium coloured, usually continuous.
       - Capillitium continuous or sparingly branched.
         - Sterile base of large cells, 2 mm. or more.
           - Exoperidium of minute connivent spines .... *L. piriforme* Schaeff.
           - Exoperidium of pointed verrucae ..... *L. perlatum* Pers.
         - Sterile base of minute cells, 1 mm. or less.
           - Exoperidium of large cruciate spines .... *L. stellatum* Cke. et Mass.
           - Exoperidium furfuraceous ..... *L. nitidum* Lloyd
       - Capillitium freely branched.
         - Sterile base cellular ..... *L. spadiceum* Pers.
         - Sterile base compact ..... *L. polymorphum* Vitt.
         - Sterile base absent ..... *L. pusillum* Pers.

Spores long pedicellate.
Sterile base well developed.
Exoperidium furfuraceous ..... *L. glabrescens* Berk.
Exoperidium of cruciate spines ..... *L. scabrum* (Lloyd) G. H. Cunn.
Sterile base scanty or absent.
Exoperidium of pallid cruciate spines ..... *L. asperum* (Lev.) de Toni.
Exoperidium furfuraceous or tomentose ..... *L. Gunnii* Berk.

3. Bovistella Morg.
(Descriptions, Proc. Linn. Soc. N.S.W., 1925, l, p. 370.)
Spores long pedicellate.
Peridium pallid tan, finely tomentose ..... *B. verrucosa* G. H. Cunn.
Peridium dark brown, areolate ..... *B. bovistoides* (C. et M.) Lloyd
Spores apedicellate ..... *B. pusilla* Lloyd

4. Bovista Dill., *ex* Persoon.
(Descriptions, Proc. Linn. Soc. N.S.W., 1925, l, p. 369.)
Capillitium pitted ..... *B. brunnea* Berk.
Capillitium not pitted ..... *B. purpurea* Lloyd

5. Disciseda Czern.
(Descriptions, Proc. Linn. Soc. N.S.W., 1927, lii, p. 236.)
Spores long pedicellate.
Spores strongly verrucose ..... *D. pedicellata* (Morg.) Hollos.
Spores verrucose-areolate ..... *D. hyalothrix* (C. et M.) Hollos.
Spores apedicellate (or apiculate, stumps only of pedicels persisting).
Spores almost smooth ..... *D. candida* (Schw.) Lloyd
Spores finely verruculose.
Stoma fimbriate-mammose ..... *D. cervina* (Berk.) G. H. Cunn.
Stoma tubular, surrounded by a depressed groove.
Spores finely verrucose-echinulate .. *D. anomala* (C. et M.) G. H. Cunn.
Spores covered with fine round-topped warts .. *D. australis* G. H. Cunn.
Spores coarsely verrucose.
Spores covered with flat-topped echinulations ..... *D. hypogaea* (C. et M.) G. H. Cunn.
Spores covered with coarse verrucae ..... *D. verrucosa* G. H. Cunn.

6. Abstoma G. H. Cunn.
(Descriptions, Proc. Linn. Soc. N.S.W., 1927, lii, p. 241.)
Gleba purple; spores finely reticulate ..... *A. purpureum* (Lloyd) G. H. Cunn.
Gleba olivaceous; spores coarsely reticulate ..... *A. reticulatum* G. H. Cunn.

7. Mycenastrum Desv.
(Description, Proc. Linn. Soc. N.S.W., 1927, lii, p. 245) .. *M. corium* (Guers.) Desv.

8. Geaster Mich.
(Descriptions, Proc. Linn. Soc. N.S.W., 1926, li, p. 76.)
Mouth peristomate.
Peristome sulcate.
Exoperidium not hygroscopic.
Endoperidium pedicellate.
Endoperidium smooth (or farinose, not roughened).
Peristome circular.
Base of the endoperidium smooth or striate ..... *G. pectinatus* (Pers.) Lloyd
Base of the endoperidium plicate ..... *G. plicatus* Berk.
Base of the endoperidium with a collar-like ring ..... *G. Bryantii* Berk.
Peristome elliptical ..... *G. ellipticis* G. H. Cunn.
Endoperidium roughened-verrucose.
Peristome concolorous ..... *G. Hariotii* Lloyd
Peristome surrounded by a silky, differently coloured zone ..... *G. Berkeleyi* Mass.
Endoperidium sessile or sub-pedicellate (*G. Hariotii*).

Exoperidium hygroscopic.
Endoperidium pedicellate.
Spores 6-8 μ diam. ..... *G. campester* Morg.
Spores 4-5·5 μ diam.
Endoperidium asperate ..... *G. Clelandii* Lloyd
Endoperidium smooth ..... *G. Smithii* Lloyd
Endoperidium typically sessile ..... *G. Drummondii* Berk.
Peristome fibrillose.
Exoperidium not hygroscopic.
Endoperidium pedicellate.
Plants typically minute ..... *G. minus* (Pers.) G. H. Cunn.
Plants typically large ..... *G. limbatus* Fries
Endoperidium sessile.
Exoperidium externally felted-tomentose or tomentose-strigose.
Plants large, 3-6 cm. ..... *G. velutinus* Morg.
Plants small, 1·5-2 cm. ..... *G. mirabilis* Mont.
Exoperidium externally smooth, or almost so.
Spores smooth or nearly so .... *G. subiculosus* Cke. et Mass.
Spores verrucose-echinulate or verrucose.
Spores 2·5-3·5 μ diam. ..... *G. saccatus* Fries
Spores 4-5 μ diam. ..... *G. triplex* Jungh.
Spores 7-8 μ diam. ..... *G. australis* Berk.
Exoperidium hygroscopic.
Endoperidium pedicellate ..... *G. arenarius* Lloyd
Endoperidium sessile ..... (*G. mammosus*)
Mouth naked.
Exoperidium not hygroscopic.
Endoperidium pedicellate.
Exoperidium typically fornicate .... *G. fenestriatus* (Pers.) G. H. Cunn.
Exoperidium revolute ..... (*G. rufescens*)
Endoperidium sessile ..... *G. fimbriatus* Fries
Exoperidium hygroscopic.
Spores 6-7 μ diam. ..... *G. floriformis* Vitt.
Spores 4-5 μ diam. ..... *G. simulans* Lloyd

Synonyms Recorded in Australasian Literature.

Bovista

anomala Cke. et Mass.	= *Disciseda anomala*
argillacea Pat.	= *Disciseda cervina*
aspera Lev.	= *Lycoperdon asperum*
candida Schw.	= *Disciseda candida*
cervina Berk.	= *Disciseda cervina*
circumscissa Berk. et Curt.	= *Disciseda candida*
debreciensis (Hazsl.) de Toni	= *Disciseda cervina*
gigantea (Pers.) Nees	= *Calvatia gigantea*
hyalothrix Cke. et Mass	= *Disciseda hyalothrix*
hypogaea Cke. et Mass.	= *Disciseda hypogaea*
lilacina Berk. et Mont.	= *Calvatia caelata*
Muelleri Berk.	= *Disciseda Muelleri*
olivacea Cke. et Mass.	= *Calvatia candida*
ovalispora Cke. et Mass.	= *Bovista brunnea*, probably
pusilla Pers.	= *Lycoperdon pusillum*
suberosa Fries	= *Mycenastrum corium*
subterranea Peck	= *Disciseda cervina*
tomentosa Vitt.	= Misdetermination
tunicata Bon.	= *Calvatia candida*

Bovistella

aspera (Lev.) Lloyd	= *Lycoperdon asperum*
australiana Lloyd	= *Lycoperdon glabrescens*
cuprica Lloyd	= *Nomen nudum*
glabrescens (Berk.) Lloyd	= *Lycoperdon glabrescens*
Gunnii (Berk.) Lloyd	= *Lycoperdon Gunnii*
nigrica Lloyd	= *Lycoperdon scabrum*
rosea Lloyd	= *Lycoperdon glabrescens*
scabra Lloyd	= *Lycoperdon scabrum*

Calvatia

aurea Lloyd	= *Calvatia candida* var. *rubro-flava*
cyathiformis (Bosc.) Morg.	= *Calvatia lilacina*
favosum (Bon.) Lloyd	= *Calvatia caelata*
Fontanesii (Dur. et Mont.) Lloyd	= *Calvatia caelata*
maxima (Schaeff.) Morg.	= *Calvatia gigantea*
occidentalis Lloyd	= *Calvatia candida*
olivacea (Cke. et Mass.) Lloyd	= *Calvatia candida*
primitiva Lloyd	= *Calvatia gigantea*
rubro-flava (Cragin) Lloyd	= *Calvatia candida* var. *rubro-flava*
Sinclairii (Berk.) Lloyd	= *Calvatia caelata*

Cycloderma

ohiense Cke.	= *Geaster velutinus*
platyspora Cke. et Mass.	= *Geaster velutinus*

Catastoma

anomalum (Cke. et Mass.) Lloyd	= *Disciseda anomala*
circumscissa (B. et C.) Morg.	= *Disciseda candida*
debreciensis (Hazsl.) Hollos	= *Disciseda cervina*
hyalothrix (C. et M.) Lloyd	= *Disciseda hyalothrix*
hypogaea (C. et M.) Lloyd	= *Disciseda hypogaea*
magnum Lloyd	= *Nomen nudum*
Muelleri (Berk.) Lloyd	= *Disciseda Muelleri*
pedicellata Morg.	= *Disciseda pedicellata*
purpurea Lloyd	= *Abstoma purpureum*
subterranea (Peck) Morg.	= *Disciseda cervina*

Disciseda

circumscissa (B. et C.) Hollos	= *Disciseda candida*
debreciensis (Hazsl.) Hollos	= *Disciseda cervina*

Geaster

affinis Col.	= *Geaster triplex*, probably
Archeri Berk.	= *Geaster triplex*
argenteus Cke.	= Misdetermination
asper (Mich.) Lloyd	= *Geaster campester*
biplicatus Berk. et Curt.	= *Geaster plicatus*
caespitosus Lloyd	= *Geaster mirabilis*
calceus Lloyd	= *Geaster minus*
coriaceus Col.	= *Geaster triplex*
coronatus Col.	= *Geaster triplex*, probably
coronatus (Schaeff.) Lloyd	= *Geaster minus*
delicatus Morg.	= *Geaster floriformis*
dubius Berk.	= *Geaster velutinus*
Englerianus Henn.	= *Geaster triplex*
fornicatus (Huds.) Fr.	= *Geaster fenestriatus*
fornicatus Fr.	= *Geaster minus*
granulosus Fcl.	= *Geaster minus*
hungaricus Hollos	= *Geaster floriformis*
hygrometricus (Pers.) Fr.	= Misdetermination
involutus Mass.	= *Geaster Drummondii*
lageniformis Vitt.	= *Geaster triplex*
lignicola Berk.	= *Geaster mirabilis*
Lloydii Bres. et Pat.	= *Geaster velutinus*
marginatus Vitt.	= *Geaster minus*
minimus (Schw.) Lloyd	= *Geaster minus*
Morganii Lloyd	= *Geaster triplex*
orientalis Hazsl.	= *Geaster Bryantii*
pseudomammosus Hollos.	= *Geaster campester*
Readeri Cke. et Mass.	= *Geaster velutinus*
Schmidelii Vitt.	= *Geaster pectinatus*
striatus Fr.	= *Geaster pectinatus*
striatulus Kalch et Cke.	= *Geaster Drummondii*
tenuipes Berk.	= *Geaster plicatus*

Geaster

tunicatus Vitt.	= *Geaster fimbriatus*
umbilicatus Quel.	= *Geaster pectinatus*
violaceus Lloyd	= *Geaster triplex*

Lycoperdon

australe Berk.	= *Lycoperdon asperum*
Bovista Fr.	= *Calvatia gigantea*
bovistoides Cke. et Mass.	= *Bovistella bovistoides*
candidum Pers.	= Misdetermination
candidum (Rostk.) Bon.	= *Calvatia candida*
cepaeforme (Bull.) Mass.	= *Lycoperdon polymorphum*
Colensoi Cke. et Mass.	= *Lycoperdon perlatum*
coloratum Peck	= *Lycoperdon polymorphum*
Cookei Mass.	= *Lycoperdon spadiceum*
coprophilum Mass.	= *Bovistella coprophila*
corium Guers.	= *Mycenastrum corium*
cruciatum Rostk.	= *Lycoperdon candidum*
dermoxanthum Vitt.	= *Lycoperdon pusillum*
favosum Bon.	= *Calvatia caelata*
Fontanesii Dur. et Mont.	= *Calvatia caelata*
furfuraceum Schaeff.	= *Lycoperdon polymorphum*
gemmatum Batsch	= *Lycoperdon perlatum*
giganteum Batsch	= *Calvatia gigantea*
hiemale Vitt.	= Misdetermination
hungaricum Hollos	= *Lycoperdon polymorphum*
lilacinum (D. et M.) Mass.	= *Calvatia lilacina*
macrogemmatum Lloyd	= *Lycoperdon perlatum*
microspermum Berk.	= *Lycoperdon pusillum*
natalense Cke. et Mass.	= *Lycoperdon depressum*
nigrum Lloyd	= *Lycoperdon polymorphum*
novae-zelandiae Lev.	= *Calvatia lilacina*
piriforme var. *flavum* Lloyd	= *Lycoperdon piriforme*
pseudopusillum Hollos	= *Lycoperdon pusillum*
pratense Pers.	= Unknown
purpuraceum Berk.	= Misdetermination
purpureum Lloyd	= *Lycoperdon purpuraceum*
reticulatum Berk.	= *Lycoperdon pusillum*, probably
retis Lloyd	= Doubtful species
rubro-flavum Cragin	= *Calvatia candida* var. *rubro-flava*
semi-immersum Lloyd	= *Lycoperdon pusillum*
Sinclairii Berk.	= *Calvatia caelata*
substellatum B. et Curt.	= Misdetermination
tasmanicum Mass.	= *Lycoperdon perlatum*
tephrum Berk.	= *Lycoperdon subincarnatum*
violascens Cke. et Mass.	= *Calvatia lilacina*
Wrightii Berk.	= Misdetermination

Mycenastrum

bovistoides Cke. et Mass.	= *Bovistella bovistoides*
chilense Mont.	= *Mycenastrum corium*
clausum Schulz.	= *Mycenastrum corium*
leptodermeum Dur.	= *Mycenastrum corium*
olivaceum Cke. et Mass.	= *Mycenastrum corium*
phaeotrichum Berk.	= *Mycenastrum corium*
radicatum Dur.	= *Mycenastrum corium*
spinulosum Peck	= *Mycenastrum corium*

Scleroderma

bovistoides (Cke. et Mass.) de Toni	= *Bovistella bovistoides*
chilense (Mont.) de Toni	= *Mycenastrum corium*
corium Grev.	= *Mycenastrum corium*
leptodermeum (D. et M.) de Toni	= *Mycenastrum corium*
olivaceum (Cke. et Mass.) de Toni	= *Mycenastrum corium*
phaeotrichum (Berk.) de Toni	= *Mycenastrum corium*
radicatum (Dur.) de Toni	= *Mycenastrum corium*
spinulosum (Peck) de Toni	= *Mycenastrum corium*